

EDITORIAL COMMENT

Remote Ultrasound: New Opportunities*

Sherif F. Nagueh, MD

Echocardiography has an established role in the evaluation of patients with cardiovascular disease. This role ranges from diagnosis to guiding percutaneous and surgical procedures. The critical role that this imaging modality plays is heavily dependent on the acquisition and accurate interpretation of satisfactory images. The use of robots and telecommunication can potentially extend the application of echocardiography to unusual circumstances and distant locations. In this issue of *JACC*, 2 studies are presented which serve as proof of concept that an approach based on telerobotics is indeed feasible.

SEE PAGES 799 AND 804

In the first study (1), the feasibility of offering cardiology consultation was tested in conjunction with robot-assisted remote echocardiography in a rural community in northern Sweden. The investigators randomized patients to the aforementioned approach versus referring patients to the nearest specialty hospital for consultation, which is the standard of care in that rural community. However, the design mandated that the patients randomized to the robotic arm receive cardiology consultation every 2 weeks, whereas in the standard of care arm, a 3-month waiting period was allowed (an important limitation). The total process time was shorter in the remote arm (27 days vs. 114 days; $p < 0.001$). This outcome occurred in the presence of similar time from clinical evaluation to randomization in the 2 arms. There were significantly more symptomatic patients in the remote arm as well as

more female subjects. This is interesting because although it can be more challenging to image these patients, the examination was completed in all subjects, and there were no significant issues related to imaging female subjects. In the end, patients considered the remote consultation arm to be the more satisfactory strategy. From the patients' perspective, they were satisfied because they could avoid travel and because of the shorter time for reaching a diagnosis and receiving treatment.

In the second study, Sengupta et al. (2) tested the feasibility of an intercity and trans-Atlantic telerobotic ultrasound system to image a vascular ultrasound phantom and a normal volunteer by using a nondedicated bandwidth. In addition to showing feasibility, advanced operators and early trainees were compared, and both appeared to have reasonable performance, although seasoned operators adjusted faster with progressive shortening of imaging time.

Both studies present data showing potentially exciting opportunities for extending the application of cardiovascular ultrasound. Nevertheless, there are several limitations and unanswered questions. We do not know whether the methods used by Sengupta et al. (2) can identify the presence of plaques and stenotic lesions or whether it can accurately determine their location and extent. Furthermore, the performance of telerobotics needs to be compared against the standard of care, a step the investigators will be embarking on this year.

Likewise, there are several unanswered questions for the first study (1). We do not know how the image quality fared in the robotic arm compared with the standard of care arm. We also do not know whether the correct diagnosis was established in the robotic arm and, if so, in how many patients. There were 8 patients in the robotic arm who had undergone previous transthoracic imaging before inclusion in the study. Unfortunately, the authors could not compare the findings between the 2 studies. Finally, going forward, it will be important to examine the impact of early diagnosis and

*Editorials published in *JACC: Cardiovascular Imaging* reflect the views of the authors and do not necessarily represent the views of *JACC: Cardiovascular Imaging* or the American College of Cardiology.

From the Methodist DeBakey Heart and Vascular Center, Houston Methodist Hospital, Houston, Texas. Dr. Nagueh has reported that he has no relationships relevant to the contents of this paper to disclose.

treatment afforded by remote imaging on clinical outcome.

In conclusion, these 2 exciting studies (1,2) expand the outreach of cardiovascular ultrasound to not only analysis, which the authors have shown before (3), but also to image acquisition by using telerobotics.

REPRINT REQUESTS AND CORRESPONDENCE: Dr. Sherif F. Nagueh, Methodist DeBakey Heart and Vascular Center, Houston Methodist Hospital, 6550 Fannin, SM-677, Houston, Texas 77025. E-mail: snagueh@houstonmethodist.org.

REFERENCES

1. Boman K, Olofsson M, Berggren P, Sengupta PP, Narula J. Robot-assisted remote echocardiographic examination and teleconsultation: a randomized comparison of time to diagnosis with standard of care referral approach. *J Am Coll Cardiol Img* 2014;7:799-803.
2. Sengupta PP, Narula N, Modesto K, et al. Feasibility of intercity and trans-Atlantic telerobotic remote ultrasound: assessment facilitated by a nondedicated bandwidth connection. *J Am Coll Cardiol Img* 2014;7:804-9.
3. Singh S, Bansal M, Maheshwari P, et al. American Society of Echocardiography: Remote Echocardiography with Web-Based Assessments for Referrals at a Distance (ASE-REWARD) Study. *J Am Soc Echocardiogr* 2013;26:221-33.

KEY WORDS echocardiography, robot-assisted, teleconsultation, telerobotic remote ultrasound assessment, ultrasound imaging